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densation of the warm surface water, which sinks into greater depths and imparts a higher degree of temperature and salinity to the substrata than are met with in any other ocean. The waters of these substrata having a temperature from 60 to 64 degrees, at a depth of 250 fathoms, meet the cold waters, in a space about 40 miles wide, descending along the edge of the continental slope, which at the same depth (250 fathoms) have a temperature of only about 45 degrees.

Within this space of forty miles' width a transition of heat and salt is effected, resulting in an entire reconstruction of the superincumbent stratum of water, producing that peculiar distribution of salt and heat at the surface that is characteristic of the Gulf stream. When warm seawater comes into contact with colder seawater it becomes heavier, for the reason that the increase of density, due to loss of heat, surpasses the decrease, due to the loss of salt. When this occurs in the depths of the ocean the warm water will sink to still greater depths, but here (as also on the slopes of great submarine banks like the Bahama, Florida and Campeche Banks) this dense and warm water touches bottom, and another shift must be made to dispose of the excess of salt, the maintenance of equilibrium being a physical necessity.

The density of warm water is less affected by the addition of a certain quantity of salt than cold water would be, and for this reason the excess of salt and heat at the bottom, on the inner edge of the Gulf Stream, shifts to higher levels where, in consequence of higher temperatures, larger quantities of salt can be stowed away with less change of density than at greater depths. Thus, by a withdrawal of salt and heat from the greater depths and their accumulation at the surface, that peculiar distribution is attained which characterizes all the serial temperature observations of the

Gulf Stream sections, including those obtained by the Challenger.

Observations show the highest specific gravities of the Gulf Stream waters to be in the latitudes of Capes Lookout and Hatteras, exceeding those of all other parts of the open ocean, and surpassed only by those of the Red Sea and of the western part of the Mediterranean.

Although the 'upheaval' of the waters of the Gulf Stream develops first in upward currents, in the substratum in which the transition of heat and salt begins, it is not improbable that these currents, like the winds in aerial circulation, may assume a more or less horizontal direction in their progress to the surface. It may also be assumed that the storage of heat in the surface stratum is not without influence upon the level of the Gulf Stream, and that this difference of level between the Gulf Stream and the adjacent areas of the ocean may call other currents into life, but a farther consideration of these subjects would lead us into the sphere of the so-called dynamics of the Gulf Stream, a field already ably discussed and sufficiently studied.

A. LINDENKOHL.

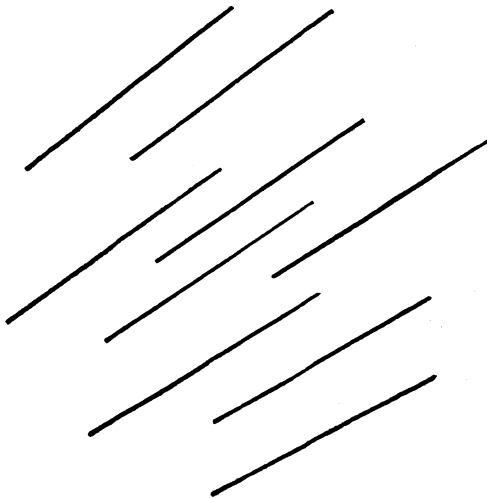
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#### AN OPTICAL ILLUSION.

THE brilliant electric lights on the borders of the lake in the Baltimore park have served to call my attention to a phenomenon which is so very familiar that one is wholly disinclined to regard it as a 'phenomenon' at all. I refer to the fact that the long stream of light reflected by the surface of the water from a lamp on the opposite side does not look like an object lying upon the surface, but like a bright post projecting down into the water, in continuation of the lamp-post. This is without doubt a particular case of the illusion by which lines which have any position whatever in planes passing through the axis of the body (or, for small near objects, in planes passing through the vertical meridian

of the one eye with which they are looked at)\* are taken by us to be vertical lines. This illusion is illustrated in Fig. 1. The lines of the figure are all drawn through a common point about three inches beyond the corner of the paper. If one eye be put in the position of this point (the other being closed), and if the paper be held horizontally about on the level of the eye, the lines will all seem to stand upright. The reason is that when one eye only is used, we have very small ground for knowing how such a line is situated in the plane determined by it and by the nodal point of the eye, and hence we take it to be a vertical line *faute de mieux*, because by far the greatest number of lines which strike the retina in this meridian are vertical lines. With many lines, the illusion is stronger than with one, because every group of vertical staves that we have ever seen has looked like this, and it has probably never happened to us to see a group of lines lying on the ground in just this position.

That this is the correct explanation of the phenomenon of the lights is confirmed by the fact that, upon looking at the reflec-



\* *Am. Jour. of Psychology*, I., 101 and James' *Principles of Psychology*, II., 95.

tion with the head inclined through an angle of ninety degrees, the illusion wholly disappears. One can no longer believe that it is possible to see the stream of light otherwise than as lying flat upon the surface of the lake. In this case the image of the line of light falls along the eyes, from one to the other, or just as a line would do which went from right to left if the head were in its normal position. Such a line we have no tendency to see vertical, and hence we now see the streak of light where it really is on the surface of the water. With the head wholly inverted, the line becomes vertical again, but less strongly so than when the head is in the customary attitude.

CHR. LADD FRANKLIN.

#### CURRENT NOTES ON PHYSIOGRAPHY.

##### THE TERTIARY PENEPLAIN IN MISSOURI.

THE prevalent opinion that the 'mountains' of the dissected Ozark plateau in Missouri are old geographical features meets welcome contradiction in an essay by Keyes, State Geologist (Missouri Geol. Survey, viii., 1894, 317-352). The relatively even upland surface of the plateau is explained as a peneplain of denudation; and the dome-like form of the plateau today is regarded as the result of elevation since the close of the Tertiary. The general upland plain is dissected by steep-sided or canyon-like trenches, in which the process of deepening is still continued. "The last elevation is not yet ended, and the changes of level in the region are probably going on now as rapidly as they ever have in the past geological time" (p. 352). While the strata are nearly horizontal in the Ozark plateau, they are tilted in the Ouachita mountains, south of the broad valley of the Arkansas river, in the State of that name. Keyes regards the relatively even crest lines of the Ouachita ridges as representing the same peneplain as that of the Ozarks; the broad valley of the Ar-